STRATEGY INSTRUCTION AND TYPE OF SEQUENCE IN CONCEPT ATTAINMENT

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Previous research has shown that sequences in which instances from the same category appear successively facilitate performance in concept attainment. This could be due to subjects adopting strategies which involve comparisons of instances from within the same category. In this study, subjects were trained to solve the concept task by comparing instances from the same or different categories. A control group received no instructions on how to solve the task. The three instructional groups were factorially combined with two types of sequences (one favoring within-category comparisons and one favoring across-category comparisons) and two different relevant dimensions. The predicted interaction between Type of Instruction and Type of Sequence was significant suggesting that the effect of a given sequence is dependent upon the extent to which the sequence provides information relevant to the strategy employed by the subject. (U)

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STRATEGY INSTRUCTION AND TYPE OF SEQUENCE IN CONCEPT ATTAINMENT

Daniel D. Blaine and Jack L. Dunham

In a theoretical consideration of the nature of concept attainment, Underwood (1952) assumed that "for relationships among stimuli to be perceived and acquired, responses to those stimuli must be contiguous (p. 212)." This suggests that in concept tasks in which Ss must learn to categorize a series of instances into a number of categories, the optimal sequence would be one in which instances from the same category would be presented without intervening instances from any other category. Several investigations of sequence manipulations in concept tasks have provided evidence supporting this prediction (e.g., Bourne & Jennings, 1963; Newman, 1956; Schulz, Miller, & Radtke, 1963).

Recently, Dominowski (1965) raised certain questions about previous research investigating contiguity effects in concept tasks. He pointed out that the results of most studies supporting the facilitative effect of contiguity could also be interpreted as due to the different number of instances required for solution by the different sequences or the presence of differential responding cues. In the case of differential responding cues, Ss have been required to give a categorical response to each instance as it was presented. With an increase in the contiguity of instances from the same category, there is an increase in the probability that instances from the same category will appear successively, i.e., runs of the same category response will tend to occur. Thus the facilitative effect of contiguity

could have been due to Ss learning to repeat certain categorical responses to a series of instances rather than the contiguity of instances from the same category.

Dominowski (1968) attempted to determine the effects of contiguity while controlling differential responding cues and the number of instances required for optimal solution. The results indicated that performance was facilitated when instances from the same category were presented successively even without additional responding cues and with the number of instances required for solution controlled. Dominowski concluded that the critical feature in a consideration of sequences in concept tasks is "the successive appearance of stimuli from the same category and that if successive appearance does not occur, the number of intervening stimuli is unimportant (Dominowski, 1968, p. 42)."

A consideration which thus far has been overlooked or given a minor role is that the effect of different sequences depends upon the strategies employed by different Ss in attempting to attain solution. In many investigations, it has been assumed that Ss are employing strategies in which hypotheses are generated from instances and compared with the information provided by successive instances (e.g., Blaine, Dunham, & Pyle, 1968; Dominowski, 1968; Dunham & Dunderson, 1969; Overstreet & Dunham, 1969). Dominowski (1968) suggested that sequence effects could be due to the less complex analytical operation in such comparisons when the category does not change from one instance to the next. When the category does not change, any dimension which changes in value is irrelevant. When the category does change, decisions cannot be made about individual dimensions. In this case, Ss must deal with a set of dimensions the same size as the problem solution.

Whenever the set of dimensions exhibits the same values in two different categories, it can only be determined that one or more of the dimensions is irrelevant. The lack of symmetry of the operations disappears when the solution to the concept task is unidimensional. When the category does not change, any dimension which changes in value is irrelevant, as in a conjunctive problem. However, when the category does change in a unidimensional problem, any dimension which does not change in value is irrelevant. Consequently an interpretation of the effect of contiguity on the basis of a difference in the analytical operations involved in testing hypotheses would not be applicable in unidimensional problems.

In a unidimensional problem, Ss can make decisions about a hypothesis just as effectively by comparing instances from different categories as instances from the same category. If Ss were to adopt a strategy involving comparisons of instances from different categories, a sequence involving maximum contiguity of instances from the same category would be nonfacilitative and, very likely, detrimental to performance. This suggests that the important aspect of a sequence of instances in concept tasks is not the contiguity of certain instances but rather the extent to which a sequence provides information relevant to S's strategy for making decisions concerning his hypotheses. Thus in this study it was hypothesized that a sequence favoring comparisons of instances from within the same category would facilitate the performance of Ss employing a strategy involving such comparisons but would impede the performance of Ss attempting to solve by making comparisons across different categories. The reverse would occur with a sequence favoring comparisons across categories.

Method

Subjects. The Ss were 75 introductory psychology students at The University of Texas at Austin. Three Ss were eliminated because of failure to follow instructions regarding task procedure.

Design. The design was a 3 x 2 x 2 factorial representing three types of instruction (within-category, across-category, and no instruction), two types of sequences (within sequence and across sequence) and two different relevant dimensions (number and shape of figures).

Materials and procedure. The concept learning tasks were unidimensional two-category problems. The stimuli were on 3 x 3 in. white cards and consisted of six binary dimensions: (*a*) number of figures, 1 or 2; (*b*) size of figures, large or small; (*c*) color of figures, black or white; (*d*) shape of figures, circle or square; (*e*) number of borders, 1 or 2; and (*f*) type of borders, solid or broken.

In all conditions the first instance and its correct category designation (either A or B) were presented to the Ss and remained in view during the entire problem. From this first instance for a given relevant dimension, two different sequences were constructed. The within sequence was limited to that subset of all instances such that when an instance from the same category as the first instance was compared with the first instance, four of the six dimensions could be logically eliminated as irrelevant. When an instance was from a category different than the first instance, only two of the six dimensions could logically be eliminated when that instance was compared with the first instance. The order of presentation of these instances was then randomized. The instances for the across sequence were selected such that any instance from the opposite category

as the first instance logically eliminated four of the six dimensions while instances from the same category as the first instance only eliminated two of the six dimensions. The instances in the across sequence were ordered such that the same logical decisions could be made about the same dimensions at the same point in the two sequences. That is, not only the same number of dimensions, but the same dimensions could be eliminated as irrelevant. Thus the sequences were equivalent in terms of the information which could logically be derived but differed with respect to whether that information was derived from a comparison of the first instance with instances from the same or different category.

All Ss were instructed on the basic structure of the concept problem and were told to use the first instance as the basis of comparison. The two strategy-instructed groups were given additional instructions and practice on how to make decisions about the relevant dimension by comparing the first instance with other instances of that category (within-category instructions) or with instances from the opposite category (across-category instructions). The Ss receiving within-category instructions were told that when two instances were from the same category, any dimension which changed in value was irrelevant. They were then shown two instances from the same category and asked to determine which dimensions were irrelevant and which could still be considered as possibly relevant. The Ss receiving across-category instructions were given the same type of instructions and practice involving instances from different categories.

The Ss were run individually with an unlimited response interval. The concept tasks were presented by the method of anticipation with the addition that Ss were asked after each trial to state which dimensions

could still be relevant. The criterion was 12 consecutive correct responses after S had correctly named the one relevant dimension.

Results

The means for trials-to-criterion in determining the relevant dimension are given in Figure 1. The interaction between Type of Instruction and Type of Sequence was significant, $F(2, 60) = 4.72$, $p < .05$. No other effect was significant.

Insert Figure 1 about here

The interaction between Type of Instruction and Type of Sequence was due primarily to the performance of the two instructed groups in the two sequence conditions. Instruction on comparing the focus with instances from the same category was detrimental to performance in the sequence favoring comparisons across categories while instruction on comparing the focus with instances of the opposite category was detrimental in the sequence favoring comparisons within categories. The groups which did not receive instruction on how to solve the concept problem attained solution as efficiently as either of the instructed groups.

Discussion

In this study, the sequences employed were equivalent in terms of contiguity and the amount of information provided. The sequences differed only according to whether it was logically more efficient to compare the first instance with instances from the same or different category. Since the sequences were equivalent in contiguity and instructions on using the

different comparisons interacted with the different sequences, it may be necessary to reconsider the variable of contiguity. The results indicate that whether a given sequence was detrimental to performance depended upon the category S employed. It is possible that contiguity is an effective variable only insofar as it affects the providing of information which S needs to make decisions by use of a particular strategy.

When Ss were forced to develop their own strategy based on the information given about the structure of the problem, they were able to adopt a strategy which was optimal in terms of the sequence presented. This does not appear to be consistent with research which suggests that a sequence favoring within-category comparisons would facilitate performance. However, previous research has, for the most part, used conjunctive concept problems with two relevant dimensions. In a conjunctive problem with two relevant dimensions, within-category comparisons are favored since Ss can deal with individual dimensions while being forced to deal with a two dimensional hypothesis for across-category comparisons. In the present study, a unidimensional problem was employed. In such problems, Ss can deal with individual dimensions whether making within- or across-category comparisons. Since this is not the case with conjunctive problems, it is reasonable that the majority of Ss would adopt a strategy involving a less complex operation, i.e., making decisions about individual dimensions rather than conjunctive hypotheses. However, it is also possible that some Ss would adopt a strategy involving the more complex operation. The results of this study do suggest the possibility that even in conjunctive problems, the sequence which is most facilitative for the majority of Ss would not necessarily be so for some Ss employing a different strategy.

In investigations of the effect of different sequences on concept attainment, the major importance has been placed on the structural aspects of sequences. The present study demonstrates that Ss employing different strategies for processing information perform differently with sequences which are equivalent in instruction contiguity and the information which can logically be derived from the sequence. That differently structured sequences can effect differences in performance is evident, but such differences depend upon the strategy employed by S and the extent to which a given sequence provides information relevant to that strategy.

References

Anderson, R. C., & Guthrie, J. T. Effects of some sequential manipulations of relevant and irrelevant stimulus dimensions on concept learning. *Journal of Experimental Psychology*, 1966, 72, 501-504.

Blaine, D. D., Dunham, J. L., & Pyle, T. W. Type and amount of available past instances in concept learning. *Psychonomic Science*, 1968, 12, 159-160.

Bourne, L. E., Jr., & Jennings, P. The relationship between response contiguity and classification learning. *Journal of General Psychology*, 1963, 69, 335-338.

Dominowski, R. L. Role of memory in concept learning. *Psychological Bulletin*, 1965, 63, 271-280.

Dominowski, R. L. Concept attainment as a function of instance contiguity and number of irrelevant dimensions. Paper presented at the annual meeting of the American Psychological Association, San Francisco, September, 1968.

Dunham, J. L., & Bunderson, C. V. Effect of decision-rule instruction upon the relationship of cognitive abilities to performance in multiple-category concept problems. *Journal of Educational Psychology*, 1969, 60, 121-125.

Newman, S. E. Effects of contiguity and similarity on the learning of concepts. *Journal of Experimental Psychology*, 1956, 52, 349-353.

Overstreet, J. D., & Dunham, J. L. Effect of number of values and irrelevant dimensions on dimension selection and associative learning in a multiple-concept problem. *Journal of Experimental Psychology*, 1969, 79, 265-268.

Schulz, R. W., Miller, R. L., & Radtke, R. C. The role of instance contiguity and dominance in concept attainment. *Journal of Verbal Learning and Verbal Behavior*, 1963, 1, 432-435.

Underwood, B. J. An orientation for research on thinking. *Psychological Review*, 1952, 59, 209-220.

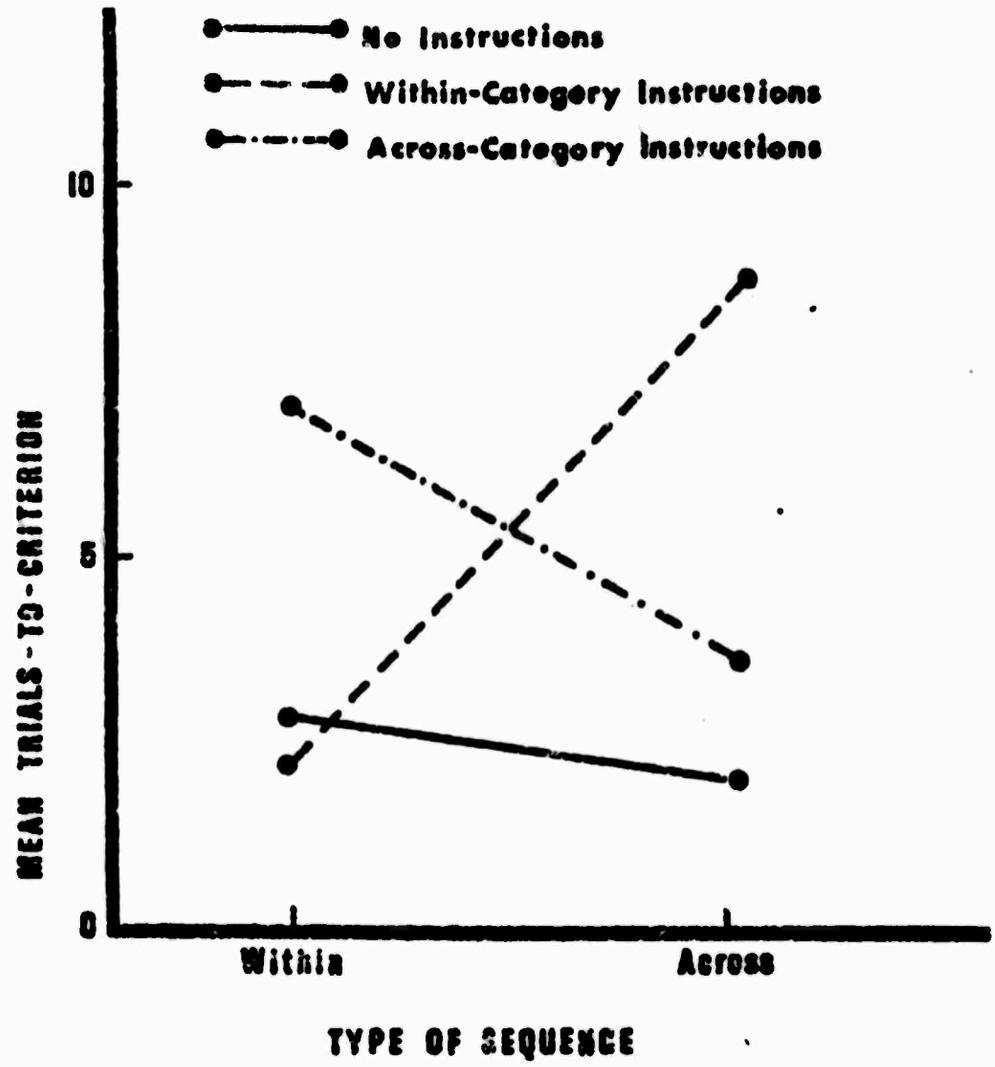

Figure 1 --Mean trials-to-criterion to determine the relevant dimension for all conditions of Type of Instruction and Type of Sequence.